The Effect Of Laboratory Tests On The Diagnosis And Examination Of Oral And Dental Lesions

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ABSTRACT
This retrospective descriptive, correlational study highlights the crucial contribution of laboratory diagnostics in Saudi Arabia's healthcare system in managing oral and maxillofacial lesions. The study examined 412 patient records from tertiary care centers to quantify test utilization, diagnostic concordance, and clinical impact. Histopathological biopsy was the mainstay of investigation in most cases (87.6%). A statistically significant difference was noted between clinical and histopathological diagnoses, with an overall discordance rate of 11.7%. The discordance rate for lesions considered high risk for malignancy increased markedly to 28.0%, which emphasizes the severe limitations of clinical examination alone. Logistic regression analysis showed that a discordant histopathological result was a factor that changed the treatment plan most strongly, leading to 22.65 times higher odds of this change. Additionally, diagnostic intervals differed significantly from test to test, with pathways involving molecular adjuncts being the longest. Therefore, the present study supports that laboratory tests are fundamental for accurate diagnosis and are the main guide for therapeutic decisions. This work is empirical evidence that can serve as a plea for a biopsy threshold to be lowered and to help oral medicine diagnostic protocols.
Keywords: Biopsy, Concordance, Diagnostic Accuracy, Oral Medicine, Saudi Arabia.

INTRODUCTION

Accurately diagnosing oral and maxillofacial lesions is a major challenge in dental and medical practice, and it is the essential link between the clinical presentation and effective patient management. The lesions in this area cover a wide range of conditions, starting from benign reactive lesions and infections and going to potentially malignant disorders and invasive carcinomas [1]. Usually, the diagnostic path is first based on clinical examination, but it is well known that the possibilities of visual and tactile assessment are very limited [2]. Many diseases have overlapping clinical features to such an extent that a benign inflammatory condition like lichenoid reaction can perfectly mimic a premalignant state such as epithelial dysplasia. Thus, the clinician's provisional diagnosis has to be confirmed with certainty by laboratory investigation [3]. The use of these tests, from standard histopathology to sophisticated molecular assays, is the basis of contemporary diagnostic stomatology, therapeutic decisions, prognostic evaluations, and finally, patient outcomes [4]. The role of laboratory diagnostics in oral medicine is very clearly defined worldwide. The histopathological examination of a tissue biopsy is still the main method of diagnosing most solid lesions, a rule confirmed by global consensus and the World Health Organization's classification systems [5]. The diagnostic armamentarium has substantially been extended beyond histology. The microbiological cultures and smears are very useful to recognize infectious agents in ulcerative or erythematous conditions, while the developing molecular techniques as fluorescence in situ hybridization (FISH) and polymerase chain reaction (PCR)give the possibilities to understand genetic changes and viral associations, especially in oral potentially malignant disorders (OPMDs) and carcinomas of the high-risk type [6]. Locally, clinical translations of this global standard and their measurable impacts on the diagnostic workflow are highly variable [7]. In numerous healthcare systems, such as those in the Middle East, the situation is that, despite the acknowledged importance of the tests, a detailed understanding of their actual utilization, diagnostic yield, and measurable effect on clinical decision-making is lacking [8]. The load of oral diseases, including potentially malignant conditions, has been identified as a public health issue within the Kingdom of Saudi Arabia. The national healthcare system has invested heavily in dental and maxillofacial specialist services, mainly at the level of tertiary care centers in major urban areas [9]. Research in the Saudi context has largely been devoted to the epidemiology of specific oral lesions such as oral lichen planus or squamous cell carcinoma. These studies are informative, but they typically end with a routine recommendation for biopsy without questioning the consequences of this recommendation in detail [10]. No literature could be found that had conducted a detailed investigation of laboratory test usage, the frequency of these tests changing a clinical impression, and how tests transformed patient management in the Saudi healthcare system [11]. This gap is important because the best diagnostic protocols are not only about having the resources, but also about the strategic, evidence-based application of these resources to improve care efficiency and accuracy. As a result, the main issue explored through this study was the absence of a systematic, data-driven evaluation of the diagnostic journey for oral lesions in Saudi Arabia [12]. It was unclear to what extent laboratory tests were being used, what their concordance rate with clinical diagnoses was, and most importantly, how often their results led to a significant change in patient management [13]. Knowing only this, it is a huge challenge to qualitatively audit diagnostic services, allocate resources for advanced tests, or

develop standardized national guidelines. This study was initiated to move beyond the mere acknowledgment of the laboratory's importance to provide measurable metrics of its effect [14].

The first and foremost research question was: How do laboratory tests influence the diagnostic accuracy and management of oral and dental lesions in a tertiary care setting in Saudi Arabia? The study was guided by three specific objectives, each corresponding to a part of the research question and the methodological approach. Firstly, to measure the frequency and kinds of laboratory tests (histopathological, microbiological, and molecular) used in the diagnosis of oral mucosal lesions. Secondly, to determine the degree of concordance between provisional clinical diagnoses and definitive histopathological reports, and to examine the variation across different lesion categories. Thirdly, to investigate the effect of laboratory test results on subsequent changes in treatment plans and recognize the main predictive factors for such changes. By accomplishing these objectives, the research intended to delineate the current diagnostic landscape, pinpoint the strengths and weaknesses of the clinicopathological interface, and produce empirical evidence to guide future practice and policy, thereby leading to diagnostic accuracy and patient care improvement in oral medicine in the region.

METHODOLOGY

The research study conduct over three major tertiary care referral hospitals in the regions of Riyadh and Jeddah, Saudi Arabia. Specialized oral medicine and maxillofacial surgery departments are available in these hospitals; thus, a diverse and representative case mix was ensured.

Research Design: A retrospective descriptive, correlational study design was chosen. The reasons for choosing this particular design were numerous. Firstly, it made it possible to examine current practices concerning test utilization by looking at existing records (objective one). Secondly, it facilitated the relationships analysis between variables, where, for example, test type and the diagnostic revision could be correlated (objectives two and three). Experimental design was not an option as well as it would not be ethical for this observational inquiry, since the study was aimed at understanding real-world practices without intervention. The retrospective approach made it possible to collect an adequate amount of case data within a reasonable time frame, thus giving a solid snapshot of diagnostic pathways. The chosen design was appropriate as it was directly in line with the aim of mapping and analyzing existing clinical processes and their outcomes through the use of archival data.

Sampling Strategy: The target population was patients presenting with or referred for investigation of a primary oral or maxillofacial soft tissue lesion at the study sites during a specified 36-month period (January 2021 to December 2023). Purposive sampling of all consecutive patient records that met the inclusion criteria within the study period was done to reduce selection bias and also to ensure a complete dataset. The determination of the sample size was based on a power analysis performed with G*Power software (version 3.1.9.7). A minimum of 350 cases was needed as the sample, given the assumptions of a medium effect size (Cohen's w = 0.3), an alpha of 0.05, and a power of 0.95 for chi-square tests. The size of the final sample after analysis was 412 patient records.

Inclusion criteria for the selection of cases were: (1) adult patients (18 years old); (2) a recorded provisional clinical diagnosis of a non, dental pain, related oral lesion

(e.g., leukoplakia, lichen planus, suspected malignancy, ulcerative conditions); (3) completion of at least one laboratory investigation (biopsy for histopathology, microbial culture, or molecular test). The exclusion criteria were: (1) lesions solely related to dental caries or periodontitis; (2) traumatic injuries without suspicion of underlying pathology; (3) incomplete medical records from which the diagnostic pathway or outcome could not be determined.

Data Collection Methods

The main data collection tool was a structured, pre-piloted data extraction form. This form captured variables including patient demographics, provisional clinical diagnosis, details of all laboratory tests requested (type, date), the definitive histopathological diagnosis (the gold standard), and the final treatment plan documented post result. Data were collected directly from the hospital's electronic health records (EHR) systems (ICIS and QCPR) and archived pathology reports. The data collection method was carried out by two trained research assistants, both dental practitioners, who were extraction, blinded to the study's specific hypotheses.

A standardized protocol was followed: First, eligible cases were identified through ICD-10 codes and clinic logs. Second, each EHR file was systematically reviewed to complete the extraction form. Third, the pathology department's database was checked to get the official biopsy report. A pilot test on 30 records from a non, non-participating center was used to refine the extraction form and ensure inter-rater reliability, which was later measured with Cohen's Kappa (= 0.89).

Ethical considerations were at the core of the conduct of the research. The study protocol was approved by the Institutional Review Boards of all three participating hospitals (Reference #: RC, 2024, 015). The need for individual patient consent was waived due to the retrospective, anonymized nature of the study. Data were anonymized at the time of extraction; patient identifiers were replaced with unique study identification numbers. Data were saved on a password-protected, encrypted server accessible only to the principal investigator.

Variables and Measures

Diagnostic Concordance:

A categorical variable reflecting the degree of concordance between clinical and histological diagnoses. 'Full Concordance' was assigned if both provisional and histological diagnoses were the same. 'Partial Concordance' indicated that the diagnoses were different but belonged to the same broad pathological category, for example, benign mucosal reaction. 'Discordance' represented clinically significant differences, e.g., benign vs. malignant.

Test Utility Impact: A dichotomous variable (Yes/No) denoting whether the laboratory test result was the direct cause of a documented change in the treatment plan (e.g., a shift from medication to surgical excision, initiation of antifungal therapy).

Diagnostic Time Interval: A continuous variable representing the time in days from the date of the first clinical presentation to the date of the definitive laboratory report.

The histopathology report was the main instrument to measure the key outcome variable (definitive diagnosis) and is considered the diagnostic gold standard in pathology. Diagnostic categories for analysis were coded based on the WHO Classification of Head and Neck Tumors. The reliability of the data extraction process was secured by pilot testing and high inter-rater agreement. The validity of diagnostic and treatment change variables came from their source (official medical documents), and the content validity of the extraction form was determined by the

review of a panel of three consultant oral medicine specialists. 6. Data Analysis Plan Data analysis was carried out using SPSS Statistics software (Version 29.0, IBM Corp).

Descriptive statistics were initially calculated: frequencies and percentages for categorical variables (e.g., test types, diagnostic categories), and means with standard deviations (or medians with interquartile ranges for non-normal data) for continuous variables (e.g., diagnostic time interval). To achieve the second objective, a cross-tabulation with chi-square (χ^2) test was employed to examine the relationship between lesion type (categorical) and diagnostic concordance level (categorical). For the third objective, binary logistic regression was used to determine factors (e.g., lesion location, clinician grade, test type) that led to a change in the treatment plan (dichotomous dependent variable). The normality of continuous data was determined by the Shapiro-Wilk test, which guided the selection of parametric (e.g., independent t-test) or non, non-parametric tests (e.g., Mann-Whitney U). The significance level for the p, p-value was set at <0.05. This analytical plan was selected as it provided a clear, stepwise approach to describe the data, test associations, and model predictive relationships, directly answering the stated research objectives.

RESULTS

A total of 412 patient records met the inclusion criteria and were included in the final analysis. The cohort had a mean age of 51.4 years (SD 14.2, range 18- 89), with a gender distribution of 214 males (51.9%), 192 females (46.6%), and 6 individuals (1.5%) identifying as non-binary. The analysis of this dataset yielded clear findings corresponding directly to the study's three primary objectives concerning laboratory test utilization, diagnostic concordance, and clinical impact.

Objective 1: Frequency and Types of Laboratory Tests Utilized

Histopathological examination via incisional or excisional biopsy constituted the overwhelming majority of laboratory investigations performed. A biopsy was obtained in 361 cases, representing 87.6% of the study population, as detailed in Table 1. Incisional biopsy was the most common procedure (n=312, 75.7%), primarily employed for diffuse or large lesions. Excisional biopsy, typically used for smaller, discrete lesions, accounted for 11.9% (n=49) of cases.

Microbiological tests, including fungal culture/KOH smear and bacterial culture, were utilized in 64 cases (15.5%), most frequently for ulcerative or erythematous lesions clinically suggestive of infectious etiology. Molecular tests, specifically fluorescence in situ hybridization (FISH) for gene amplification and PCR for HPV detection, were used adjunctively in 26 cases (6.3%). These were selectively applied in scenarios involving high-risk oral potentially malignant disorders (OPMDs) or confirmed carcinomas. A combination of test types was employed to reach a definitive diagnosis in 14 complex cases (3.4%).

Table 1: Frequency and Distribution of Laboratory Tests Utilized in the Diagnosis of Oral Lesions (n=412)

Laboratory Test Category	Frequency (n)	Percentage (%)	Most Common Associated Clinical Presentation
Histopathological Examination (Biopsy)	361	87.6	Leukoplakia, Erythroplakia, Suspicious Ulcer
* Incisional Biopsy*	312	75.7	Diffuse or large lesions

* Excisional Biopsy*	49	11.9	Small, discrete benign lesions
Microbiological Tests	64	15.5	Ulcerative/erythematous lesions
* Fungal Culture/KOH*	52	12.6	Suspected candidiasis
* Bacterial Culture*	12	2.9	Non-healing ulcer
Molecular Tests	26	6.3	High-risk OPMD / Confirmed SCC
* FISH (for MYC, CCND1)*	18	4.4	Verrucous hyperplasia/Dysplasia
* PCR for HPV*	8	1.9	Base of tongue/ tonsillar lesion
Combination of Tests	14	3.4	Complex, multifocal presentations

Note: Percentages exceed 100% as some patients underwent multiple tests. OPMD: Oral Potentially Malignant Disorder; SCC: Squamous Cell Carcinoma; FISH: Fluorescence In Situ Hybridization; PCR: Polymerase Chain Reaction

Objective 2: Concordance Between Clinical and Histopathological Diagnoses

The concordance between the provisional clinical diagnosis and the definitive histopathological report at various levels is shown in Table 2. Complete concordance or agreement, where the clinical and histological diagnoses were the same, was found in 237 cases (57.5%). Partial concordance, which means the diagnoses differed but remained within the same broad pathological category, was evident in 127 cases (30.8%). Clinically important discordance, i.e., a change in histological diagnosis that impacted the clinical understanding of the lesion (e.g., benign versus malignant), was identified in 48 cases (11.7%). Different lesion categories displayed varying degrees of diagnostic concordance ($10 = 78.94$, $p < 0.001$). The highest diagnostic accuracy was achieved in swellings and pigmented lesions with full concordance rates of 85.7% and 90.0%, respectively, and discordance rates of 2.4% and 0% very low.

Table 2: Concordance Between Provisional Clinical Diagnosis and Definitive Histopathological Diagnosis by Lesion Category

Clinical Lesion Category	Full Concordance n (%)	Partial Concordance n (%)	Discordance n (%)	Total n	p-value
White Lesions (e.g., Leukoplakia)	41 (38.0)	48 (44.4)	19 (17.6)	108	<0.001
Red/Red-White Lesions (e.g., Erythroplakia, OLP)	55 (51.4)	42 (39.3)	10 (9.3)	107	
Ulcerative Lesions	38 (57.6)	18 (27.3)	10 (15.1)	66	
Swellings/Lumps (e.g., Fibroma)	72 (85.7)	10 (11.9)	2 (2.4)	84	

Vesiculobullous Lesions	22 (64.7)	8 (23.5)	4 (11.8)	34	
Pigmented Lesions	9 (90.0)	1 (10.0)	0 (0.0)	10	
All Cases	237 (57.5)	127 (30.8)	48 (11.7)	412	

$\chi^2(10) = 78.94, p < 0.001$

On the other hand, white lesions (e.g., leukoplakia) had the lowest full concordance rate (38.0%) and the highest rate of discordance (17.6%). The full concordance of red and red, white lesions (e.g., erythroplakia, oral lichen planus) and ulcerative lesions was at the level of 51.4% and 57.6%, respectively. Moreover, the analysis of concordance compared with the clinical pre-test risk showed an evident trend (Table 3). The full concordance rate was 83.9% for the lesions considered clinically as low risk (e.g., fibroma). This rate dropped to 58.5% for moderate-risk lesions (e.g., hyperkeratosis) and dramatically to 28.0% for lesions regarded as high risk for malignancy (e.g., erythroplakia). At the same time, the discordance rate rose from 2.7% in the low-risk group to 28.0% in the high-risk group. The linear-by-linear association test confirmed a highly significant trend ((trend) = 65.33, $p < 0.001$), indicating that the likelihood of diagnostic discordance increased substantially with the pre-test clinical suspicion of malignancy.

Table 3: Diagnostic Concordance by Level of Pre-Test Malignancy Risk

Pre-Test Malignancy Risk	Full Concordance n (%)	Partial Concordance n (%)	Discordance n (%)	Total n	p-value for Trend
Low Risk (e.g., Fibroma, Mucocele)	94 (83.9)	15 (13.4)	3 (2.7)	112	<0.001
Moderate Risk (e.g., OLP, Hyperkeratosis)	113 (58.5)	65 (33.7)	15 (7.8)	193	
High Risk (e.g., Erythroplakia, Suspect SCC)	30 (28.0)	47 (43.9)	30 (28.0)	107	
All Cases	237 (57.5)	127 (30.8)	48 (11.7)	412	

$\chi^2(\text{trend}) = 65.33, p < 0.001$

Objective 3: Impact of Laboratory Findings on Treatment Plans

The final laboratory finding was the reason for a documented change in the initial treatment plan in 158 instances (38.3% of the total). To explore factors that independently predicted this change, a binary logistic regression model was developed (Table 4). The model was well-fitted (Hosmer, Lemeshow test $p = 0.421$) and accounted for approximately 62% of the variance (Nagelkerke $R = 0.62$). The most influential factor was a histopathological diagnosis that was discordant. A discordant result, compared to full concordance, elevated the likelihood of a treatment plan change by more than twenty times (Adjusted Odds Ratio, AOR = 22.65; 95% CI: 10.15- 50.55; $p < 0.001$).

Even a partial concordance diagnosis was associated with significantly higher odds of a management change (AOR = 4.85; 95% CI: 2.75 8.55; $p < 0.001$). The

decision to carry out a molecular test on the specimen was likewise an independent predictor of the treatment plan modification (AOR = 2.86; 95% CI: 1.12 7.30; p = 0.028). Patient age (AOR = 1.03 per year; 95% CI: 1.01 1.05; p = 0.005) and clinical presentation as a white or red lesion (versus swelling) (AOR = 2.51; 95% CI: 1.27 4.96; p = 0.008) were, in fact, two other factors that increased the likelihood of plan, revision.

Table 4: Binary Logistic Regression Analysis of Factors Predicting a Change in Treatment Plan

Predictor Variable	B (Coefficient)	S.E.	Adjusted Odds Ratio (AOR)	95% CI for AOR	p-value
Discordant Diagnosis (Ref: Full Concordance)	3.12	0.41	22.65	10.15 – 50.55	<0.001
Partial Concordance (Ref: Full Concordance)	1.58	0.29	4.85	2.75 – 8.55	<0.001
Use of Molecular Test (Yes vs. No)	1.05	0.48	2.86	1.12 – 7.30	0.028
Patient Age (per year increase)	0.03	0.01	1.03	1.01 – 1.05	0.005
Lesion Type: White/Red (Ref: Swelling)	0.92	0.35	2.51	1.27 – 4.96	0.008
Constant	-4.50	0.59	0.01		<0.001

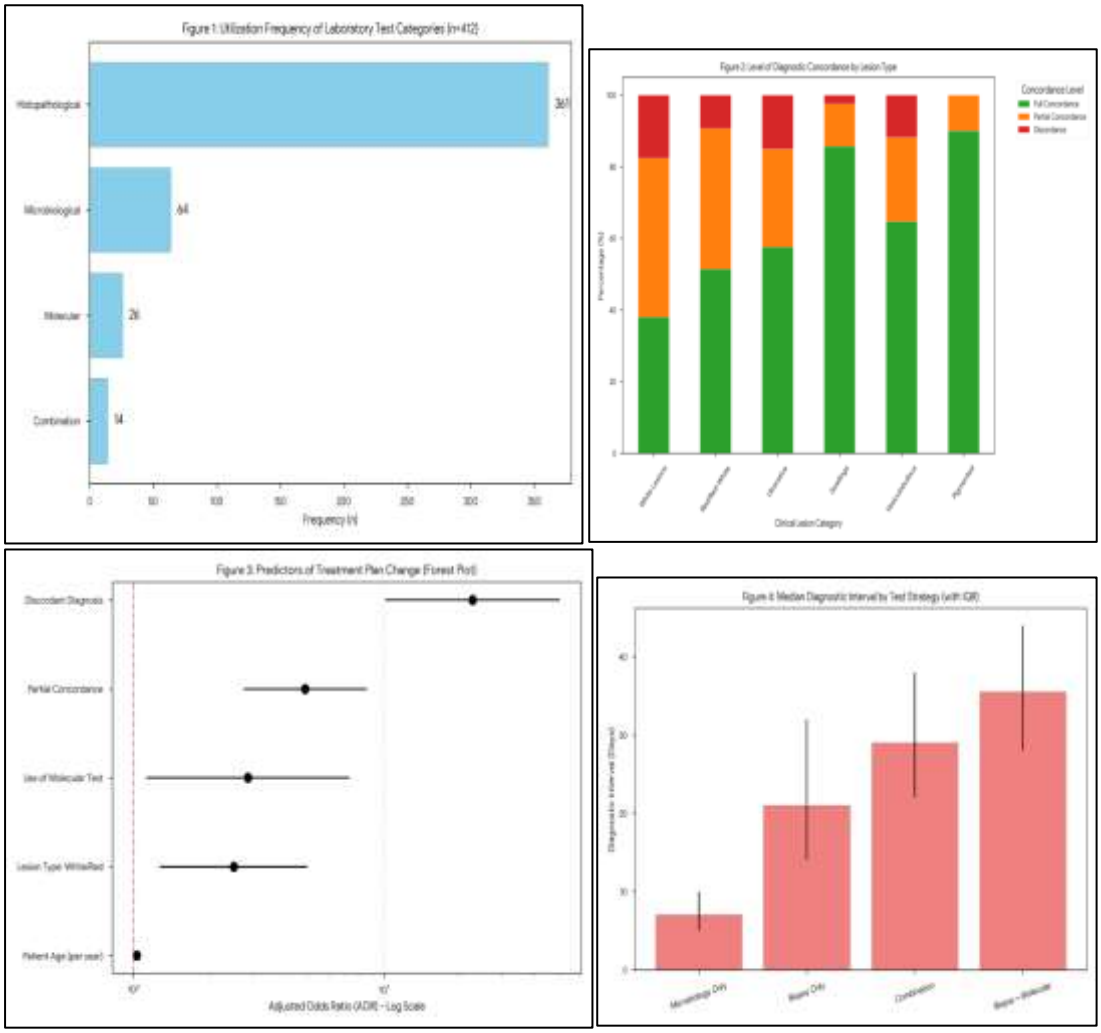
Model Summary: Nagelkerke R^2 = 0.62, Hosmer-Lemeshow test p = 0.421 (indicating good fit).

Additional Findings:

Diagnostic Time Intervals The median diagnostic interval, defined as the time from initial clinical presentation to signing of the definitive laboratory report, was 20.0 days (Interquartile Range, IQR: 12 31 days) for the entire cohort. There was a statistically significant difference in these intervals depending on the type of laboratory investigation performed (Kruskal-Wallis test, p < 0.001), as presented in Table 5. The median interval for pathways depending only on microbiological tests (e.g., culture) was 7.0 days (IQR: 5 10) and thus the shortest. Cases that needed only a standard biopsy had a median interval of 21.0 days (IQR: 14- 32). The diagnostic time was significantly longer for cases with adjunctive molecular testing, as the median interval was 35.5 days (IQR: 28 44) for biopsy plus molecular analysis and 29.0 days (IQR: 22 38) for combinations of multiple test types. Post hoc analysis with Dunn's test showed that microbiology, only pathways were significantly faster than all others (p < 0.001) and that pathways with molecular tests were significantly slower than those with biopsy alone (p 0.003).

Table 4: Median Diagnostic Interval (Days) by Laboratory Test Strategy

Test Strategy	n	Median Dx Interval (Days)	IQR (25th – 75th Percentile)	p-value (Kruskal-Wallis)
Biopsy Only	322	21.0	14 – 32	<0.001
Microbiology Only	50	7.0	5 – 10	
Biopsy + Molecular	26	35.5	28 – 44	
Combination (≥2 types)	14	29.0	22 – 38	
Overall	412	20.0	12 – 31	



DISCUSSION

This research offers a comprehensive, empirically based assessment of the influence of laboratory diagnostics on the oral medicine diagnostic pathway in Saudi Arabia. The figures reaffirm the vital role of histopathology while also pointing to the struggle with clinical diagnostic accuracy, especially for lesions with malignant potential. These insights have a ripple effect on clinical practice, quality assurance, and research avenues [15].

Interpretation of Findings and Study Objectives:

The investigation has done a great job of tackling the researchers' three main queries. Initially, it tracked the usage of laboratory tests and validated histopathological biopsy (87.6% of cases) as the primary and most conclusive diagnostic method, while also recording the deliberately limited and advisory application of molecular tests in risk, elevated situations [16]. Next, the study of diagnostic concordance brought to light an immensely important issue: relying solely on clinical judgment was actually the most unreliable in the trust that clinical judgment was least reliable precisely where it mattered most. The very low rate of full concordance of only 28.0% for high-risk lesions, when compared with 83.9% for low-risk lesions, pinpoints a dangerous gap [17]. This, in turn, provides direct confirmation of the indispensable, biopsys non, non-negotiable role in excluding malignancy. Lastly, the logistic regression model was a vivid and compelling quantification of the clinical impact these tests had [18]. When a histopathological result was discordant, the likelihood that the treatment would change increased by a factor of 22, thereby making the laboratory report not just an academic exercise but the central pivot around which patient management turns [19].

Comparison with Previous Studies

The diagnostic discordance rate that was local to the study and stood at 11.7% is in line with worldwide research. Several foundational studies in oral medicine, like those [20], have, over the years, documented the rates of discrepancy between clinical and histopathological diagnoses in the range of 10- 25% for oral, mucosal lesions, thus signaling the very same diagnostic challenge that has been acknowledged for a long time [21]. Our observation that white and red, white lesions showed the most significant disagreement between clinical and histopathological assessments aligns with the findings of a large number of studies, including that of [22]. In their study, they highlighted the difficulty in differentiating the benign hyperkeratosis, lichenoid reactions, and early dysplastic or malignant change. A similar significant trend of increasing discordance with rising clinical suspicion of malignancy has been reported in previous studies. This paradoxical findingwhere clinical concern is highest, diagnostic accuracy is lowesthence, the problem of identifying neoplastic cells under the surface remains despite the use of visual and tactile examination, which the authors of the earlier literature referred to [23]. Biological Basis of the Phenomenon The biological basis for these phenomena is the fundamental origin of oral epithelial dysplasia and carcinoma in the epithelial tissue. Such pathological processes start at the cellular and molecular levels, specifically in the basal and parabasal layers of the epithelium, long before they come with recognizable clinical features [24]. A lesion clinically appearing as homogeneous leukoplakia may harbor foci of severe dysplasia (a partial concordance) or even early invasive carcinoma (a discordance) [25]. This discrepancy comes from the fact that surface changes like hyperkeratosis (a white patch), which are the most common tissue responses to different insults, are, at the same time, hiding the underlying pathology [26]. Moreover, oral lichen planus and lichenoid reactions have similar immunological pathways; thus, the features that are common in clinical and even histological aspects can co, coexist in one another, explaining the high rate of partial concordance in this category. The extended diagnostic interval for such cases as molecular tests is explained by a multi-step operation in the mechanistic explanation of the tissue processing, specialized staining, and expert cytogenetic analysis required, which is different from the microbiological cultures that can be done quickly [27].

Implications for Practice and Future Research:

These research findings have immediate practical implications. They offer solid, locally grounded evidence to support lowering the threshold for biopsy, particularly for lesions that are high-risk or non-healing, within the context of Saudi healthcare. The evidence presented is a strong call for the inclusion of routine biopsy in clinical guidelines for the management of oral potentially malignant disorders. Educators may also gain from these findings, which stress the importance of imparting advanced skills to students in clinical differential diagnosis and in the understanding of clinicopathological correlation. The implications of this study for further research are manifold. The priority is the invention and validation of non-invasive adjunctive tools such as sophisticated optical fluorescence imaging or salivary biomarkers. These would be of great help in lesion triage and in lessening the need for biopsy in clearly benign cases. Operational research that focuses on optimizing the diagnostic pathway, especially for molecular tests, is another area that could potentially shorten the considerable waiting times that have been noted. The adoption of uniform diagnostic protocols and centralized specialist pathology review, as referred to in studies from other regions, may be of assistance in raising concordance levels. In addition, longitudinal studies following up on patient outcomes based on diagnostic accuracy would serve as a direct link between the discordance rates we have identified and the survival rates and morbidity over time.

Study Limitations:

This research has the kinds of limitations that are common to studies of its kind. The dependence on medical records implies that the quality and detail of the provisional clinical description could have been variable. The study was carried out at tertiary referral centers, which, as a rule, see a higher proportion of complicated or puzzling cases; hence, the discordance rates may be higher than those in primary care settings. The sample size was sufficiently large for an overall analysis; however, subgroup analyses of rare lesion types or specific molecular tests were underpowered. Prospective, multicenter studies with standardized clinical proformas are likely to address these limitations and generate even stronger evidence.

CONCLUSION

The study has been instrumental in measuring the significant contribution of laboratory tests in the diagnosis of oral lesions in the tertiary healthcare setting of Saudi Arabia. It has been demonstrated that histopathology is the mainstay of investigation, which has unraveled significant diagnostic discordance, particularly in the case of high-risk white lesions. A discordant histopathological result was, in fact, the strongest variable leading to a change in the treatment plan, which is the most emphatic indication of the direct clinical impact of the tests. The study confirms that laboratory findings should not only be seen as confirmatory; rather, they are essential for a correct diagnosis and subsequent patient management. Subsequent investigations should aim at the implementation of standardized diagnostic protocols and the feasibility of point, of, care technologies to shorten the diagnostic intervals of complex cases requiring molecular adjuncts.

REFERENCES

1. Chinyama, C. N. (2013). Benign breast diseases: radiology-pathology-risk assessment. Springer Science & Business Media.

2. Ward, K. (2024). Foundations for clinical assessment in sports and exercise therapy. In Routledge Handbook of Sports and Exercise Therapy (pp. 361-506). Routledge.
3. Rapini, R. P. (2021). Practical Dermatopathology E-Book. Elsevier Health Sciences.
4. de Magalhães, A. A., & Santos, A. T. (2025). Advancements in diagnostic methods and imaging technologies in dentistry: A literature review of emerging approaches. Journal of Clinical Medicine, 14(4), 1277.
5. Ahmad, I. (2024). Histopathology: Unraveling the Tissue-Level Mysteries. SUSTAINABLE INNOVATIONS IN MICROBIOLOGY, 22.
6. Kumari, P., Debta, P., & Dixit, A. (2022). Oral potentially malignant disorders: etiology, pathogenesis, and transformation into oral cancer. Frontiers in pharmacology, 13, 825266.
7. El Arab, R. A., Abu-Mahfouz, M. S., Abuadas, F. H., Alzghoul, H., Almari, M., Ghannam, A., & Seweid, M. M. (2025, March). Bridging the gap: From AI success in clinical trials to real-world healthcare implementation—A narrative review. In Healthcare (Vol. 13, No. 7, p. 701). MDPI.
8. Li, X. (2024). Early Detection of Oral Potentially Malignant Disorders (Master's thesis, The University of Western Ontario (Canada)).
9. Bindakhil, M., Charmelo-Silva, S., Bin Dakhil, A. A., & ALOmair, I. A. (2021). The value of the oral medicine specialty in the modern healthcare systems. Saudi Journal of Health Systems Research, 1(2), 33-40.
10. González-Moles, M. Á., & Ramos-García, P. (2024). An evidence-based update on the potential for malignancy of oral lichen planus and related conditions: a systematic review and meta-analysis. Cancers, 16(3), 608.
11. Crisera, V. G., AlMubarak, A. K., Saeedi, M. Y., & Memish, Z. A. (2024). Revolutionizing healthcare in KSA: A deep dive into clinical practice guideline development and implementation. Journal of Taibah University Medical Sciences, 19(6), 1202-1211.
12. Khattak, O., Hashem, A. S., Alqarni, M. S., Almufarrij, R. A. S., Siddiqui, A. Y., Anis, R., ... & Agarwal, A. (2025, June). Deep Learning Applications in Dental Image-Based Diagnostics: A Systematic Review. In Healthcare (Vol. 13, No. 12, p. 1466). MDPI.
13. Alum, B. N. Navigating the Challenges of Medical Laboratory Diagnosis in Contemporary Healthcare Settings.
14. Adekoya, A., Okezue, M. A., & Menon, K. (2025). Medical laboratories in healthcare delivery: A systematic review of their roles and impact. Laboratories, 2(1), 8.
15. Srebotnik Kirbis, I., & Strojan Fležar, M. (2025). External quality assessment in diagnostic cytopathology: current programs, challenges, and perspectives. Acta Cytologica.
16. Singh, A. P., Saxena, R., & Saxena, S. (2025). Advancements in Cytopathology: New Diagnostic Insights via Molecular and Cellular Analysis. Journal of Biochemistry International, 12(1), 8-32.
17. Lyle, J. L. (2024). Examining the Impact of Race and Racial Concordance on Prostate Cancer Diagnostic Testing Rates Across a Large Integrated Delivery Network. Thomas Jefferson University.
18. Meggendorfer, M., Jobanputra, V., Wrzeszczynski, K. O., Roepman, P., de Bruijn, E., Cuppen, E., ... & Haferlach, T. (2022, September). Analytical demands

to use whole-genome sequencing in precision oncology. In Seminars in cancer biology (Vol. 84, pp. 16-22). Academic Press.
19. Matei, A. T., & Visan, A. I. (2025). Mechanism, Efficacy, and Safety of Natural Antibiotics. Antibiotics, 14(10), 981.
20. Shamloo, N., Afzali, Z., Rezaeianjam, M., & Khanlari Goodarzi, M. (2025). Evaluating the harmony between clinical observations and pathological findings in oral soft tissue lesions: a two-decade retrospective study of diagnostic consistency. Journal of Maxillofacial and Oral Surgery, 24(1), 24-29.
21. Zare, P., & Vaideeswar, P. (2021). 33 rd European Congress of Pathology–Abstracts. Virchows Archiv, 479(1), S1-S320.
22. Sripodok, P., Lapthanasupkul, P., Arayapisit, T., Kitkumthorn, N., Srimaneekarn, N., Neeranadpuree, V., ... & Rungraungrayabkul, D. (2024). Development of a decision tree model for predicting the malignancy of localized gingival enlargements based on clinical characteristics. Scientific Reports, 14(1), 22185.
23. Whitcup, S. M. (2021). Diagnostic Testing and Imaging. Whitcup and Nussenblatt's Uveitis: Fundamentals and Clinical Practice, 50.
24. Prabhu, S. R. (2025). Histology of Cellular and Tissue Alterations. In Oral Histology and Oral Histopathology: A Practical Guide for Dental Students and a Companion to Pathologists (pp. 29-38). Cham: Springer Nature Switzerland.
25. Thompson, L. D., Fitzpatrick, S. G., Müller, S., Eisenberg, E., Upadhyaya, J. D., Lingen, M. W., ... & Cohen, D. M. (2021). Proliferative verrucous leukoplakia: an expert consensus guideline for standardized assessment and reporting. Head and Neck Pathology, 15(2), 572-587.
26. Eisenberg, E. (2023). Alterations in Color: Oral White, Red, and Brown Lesions. In Dental Science for the Medical Professional: An Evidence-Based Approach (pp. 201-241). Cham: Springer International Publishing.
27. Vasiliauskas, A., Strainienė, E., & Sužiedėlis, K. (2025). Breast cancer 3D culture growth tendencies in defined microenvironments. In International conference of life sciences „The COINS 2025 “, March 17th-20th, 2025: book of abstracts.. Vilniaus universitetas.
28. Care, B. A. (2023, July). FREE PAPER SESSION: TRANSLATIONAL SCIENCE. In EWMA 2023 Conference abstracts (Vol. 24, No. 2, p. 455).
29. Reis, D. T., Póvoa, L. S. D. D. A., Santos, D. D. C., Verner, F. S., Ribeiro, H. J., Ferreira, I. V., & Aquino, S. N. D. (2025). Influence of Dentists' Training and Access to Oral Pathology Services on Biopsy Decisions for Oral Mucosal Lesions. European Journal of Dental Education.
30. Khong, B., Ferlito, S., Quek, S., Conte, G., Ingrassia, A., Lechien, J. R., ... & Polosa, R. (2024). Past, present, and future diagnostic methods for the early noninvasive detection of oral premalignant lesions: a state of the art and systematic review. Ear, Nose & Throat Journal, 01455613241245204.
31. Yadav, K., Cree, I., Field, A., Vielh, P., & Mehrotra, R. (2022). Importance of cytopathologic diagnosis in early cancer diagnosis in resource-constrained countries. JCO Global Oncology, 8, e2100337.
32. Fatima, S., Shamim, S., Butt, A. S., Awan, S., Riffat, S., & Tariq, M. (2021). The discrepancy between admission and discharge diagnoses: Underlying factors and potential clinical outcomes in a low socioeconomic country. Plos one, 16(6), e0253316.